

*Erwin Library & High School*

# Geothermal Study

Performed For

*Erwin Utilities*

by

**Earth Energy**  
*Engineering Inc.*

April 1997

# EARTH ENERGY

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*Engineering Inc.*

Federal ID No. 54-1770369

TN Statewide Mech. Contractor No. 38861 CMC-C

P.O. Box 322

Big Stone Gap, Va. 24219

Bill Nagel - VP Engr  
tel. (540) 523-2283  
April 29, 1997

Lee H. Brown  
Manager of Operations  
Erwin Utilities  
PO Box 201  
Erwin, Tennessee 37650

Lee,

Please find enclosed the drill logs and results of the thermal conductivity study we performed at the proposed Erwin Library and High School locations.

Two 1" Phillips uniscoils were installed at the new site for the Erwin Library at a depth of 330 feet. ~~Six~~<sup>Four</sup> inch steel casing was left imbedded in bedrock at 102 feet and the remainder of the hole drilled with a 4" hammer. The boreholes were grouted by means of a tremie pipe utilizing high solids bentonite grout. One loop was chosen for the thermal conductivity test and utilizing a Ewbank and Associates "suitcase" test unit we performed the test on February 27, 1997. The thermal conductivity was calculated as **1.43 Btu/hour/degree/foot**. This is an average of the entire borehole. All test methods, interpretations, and procedures were done in accordance with the

recommendations and guidelines of the International Ground Source Heat Pump Association.

A similar test was done at the site of the proposed Unicoi Co. High School on the morning of February 28, 1997. Here the loop was installed at a depth of 380 feet. 120 feet of casing was required to complete the hole, but was retrieved after loop insertion. The same method of grouting was used as above. Generator speed fluctuated somewhat accounting for observable temperature movements. The thermal conductivity was calculated as **1.54 Btu/hour/degree/foot**.

For reference, thermal conductivity of various materials is shown below:

- |                     |     |
|---------------------|-----|
| 1. Dense rock       | 2.0 |
| 2. Average rock     | 1.4 |
| 3. Dense concrete   | 1.0 |
| 4. Solid masonry    | .75 |
| 5. Heavy soil, damp | .75 |
| 6. Heavy soil, dry  | .50 |
| 7. Light soil, damp | .50 |
| 8. Light soil, dry  | .20 |

Thermal conductivity values along with monthly heating/cooling loads for the building and specified equipment efficiency ratings will allow the thermal field to be accurately and economically designed for optimum performance.

A total of four holes were drilled at the High School site. Two were successful and have loops inserted to the depth of 380 feet. Two others were abandoned at 126 feet and 99 feet when mud seams and cobble prevented advancement and the insertion of casing. This field will be usable as a geothermal heat exchanger but will likely require more costly underreaming, drilling methods.

We at Earth Energy Engineering appreciate the opportunity to be of service to you and have really enjoyed working with you. Please call if we can be of further assistance.

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## **Drill log information**

**Core drill location:** Erwin High School Boring # 1  
**State:** Tennessee  
**County:** Unicoi  
**Started:** 1-16-97  
**Finished:** 1-21-97  
**Driller:** Byrd Hensley

Depth		Thickness	Description
From	To		
0'	27'	27'	Clay & Small Gravel (Water)
27'	60'	33'	Loose Gravel & Sand
60'	90'	30'	Loose Gravel, Sand & Large Cobbles (Boulders)
90'	101'	11'	Boulder (Limestone)
101'	102'	1'	Clay Void
102'	115'	13'	Cobbles & Gravel
115'	184'	69'	Limestone (Dolomite)
184'	189'	5'	Fracture Zone (Dolomite) Small Fractures
189'	207'	18'	Dolomite
207'	209'	2'	Fracture (Water) Dolomite
209'	211'	2'	Clay (Gray) w/Pebbles
211'	386'	175'	Dolomite
	386'		Total Depth

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## **Drill log information**

**Core drill location:** Erwin High School Boring # 2  
**State:** Tennessee  
**County:** Unicoi  
**Started:** 1-16-97  
**Finished:** 1-29-97

Depth		Thickness	Description
From	To		
0'	27'	27'	Clay & Small Gravel (Water)
27'	60'	33'	Loose Gravel & Sand
60'	90'	30'	Loose Gravel, Sand & Large Cobbles (Boulders)
90'	100'	10'	Boulders, Gravel & Sand
100'	102'	2'	Boulder
102'	115'	13'	Cobbles & Gravel
115'	126'	11'	Limestone (Dolomite)
	126'	0'	Total Depth

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## **Drill log information**

**Core drill location:** Erwin High School Boring # 3  
**State:** Tennessee  
**County:** Unicoi  
**Started:**  
**Finished:** 2-4-97

Depth		Thickness	Description
From	To		
0'	11'	11'	Soil & Clay
11'	27'	16'	Sandy Soil
27'	40'	13'	Loose Gravel & Sand
40'	43'	3'	Boulder
43'	89'	46'	Cobbles & Gravel
89'	91'	2'	Silt & Clay
91'	99'	8'	Limestone (Dolomite)
	99'	0'	Total Depth

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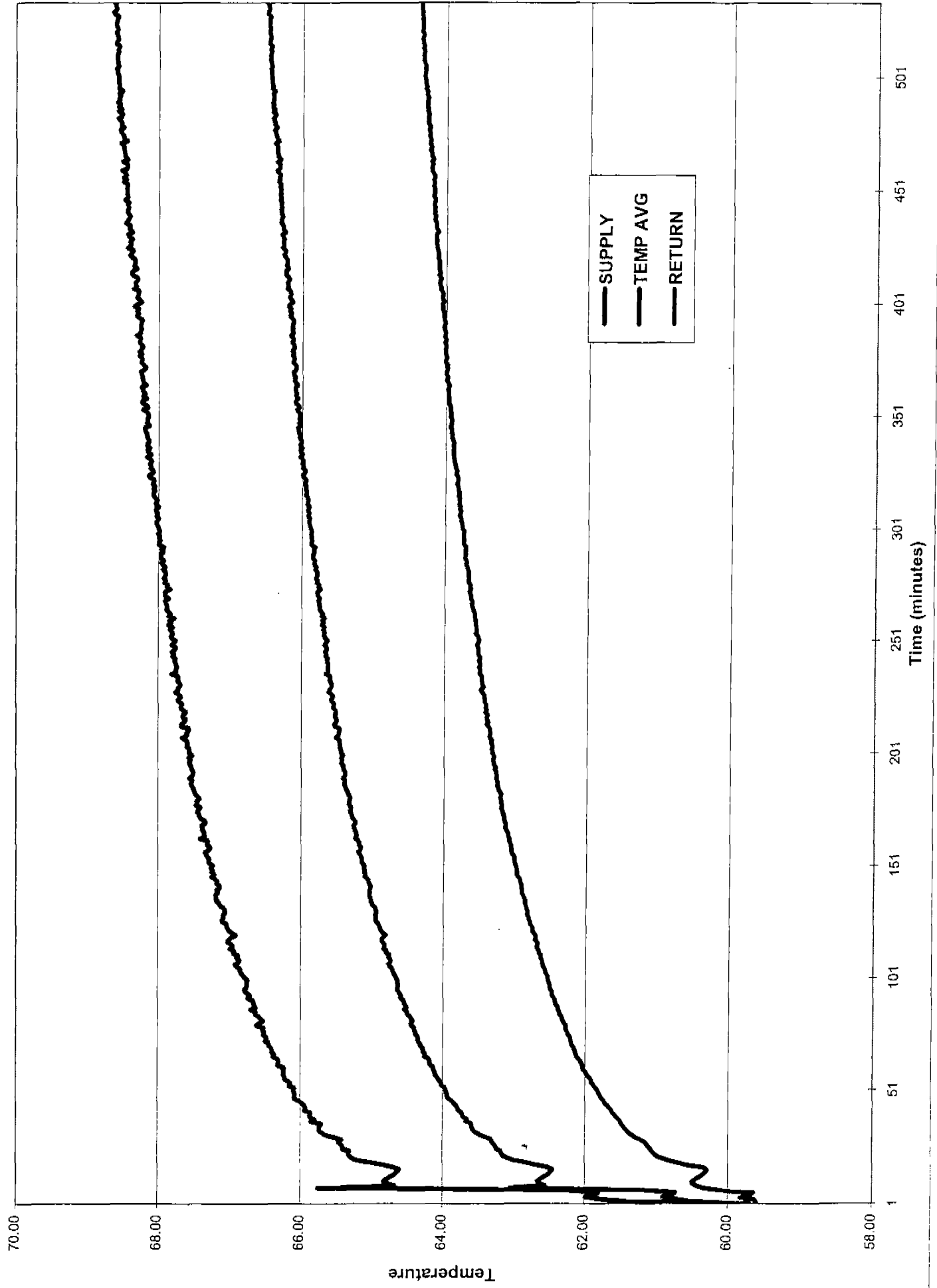
(540) 523-2283

## **Drill log information**

**Core drill location:** Erwin High School Boring # 4  
**State:** Tennessee  
**County:** Unicoi  
**Started:** 2-18-97  
**Finished:** 2-20-97  
**Driller:** Byrd Hensley

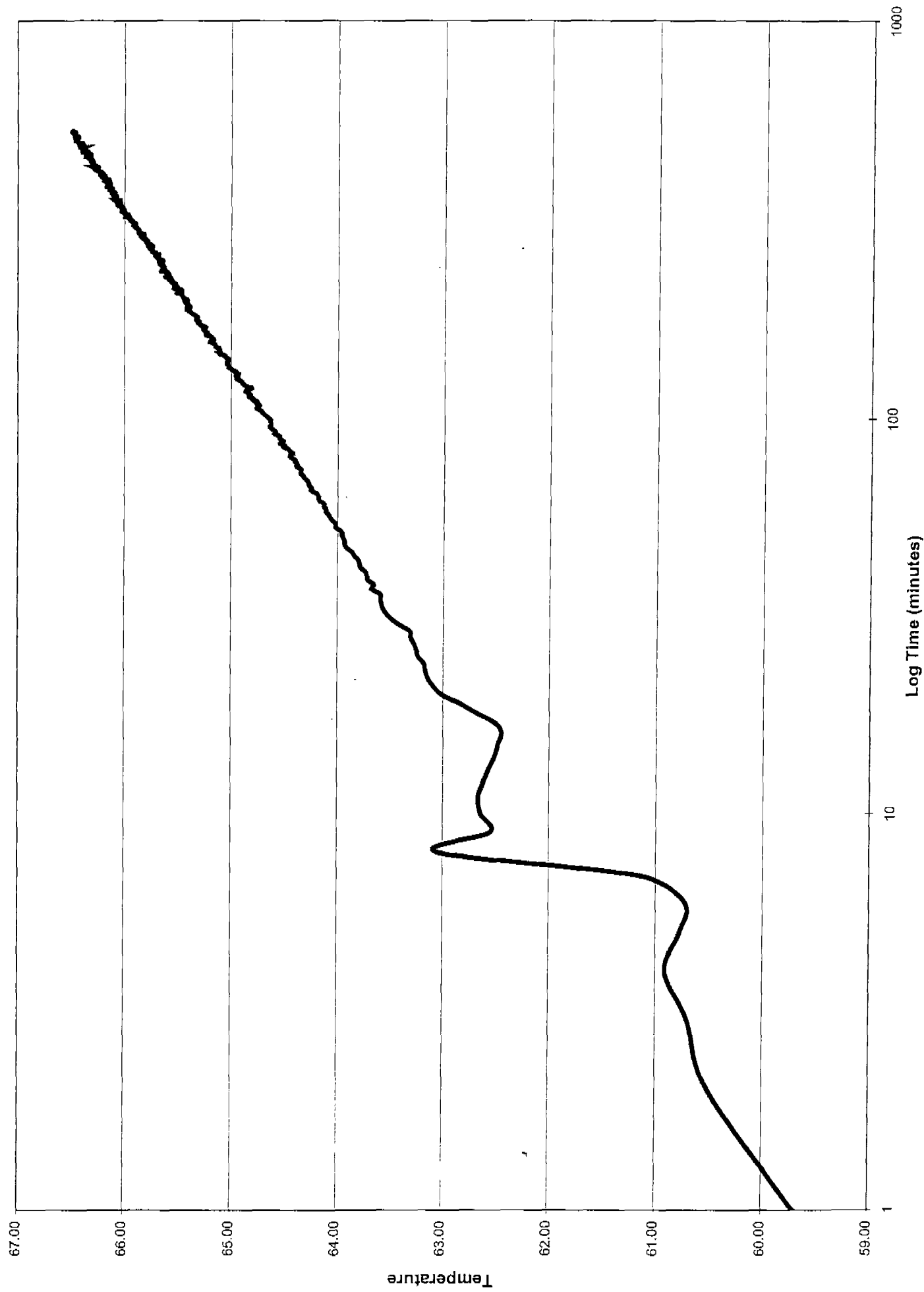
Depth		Thickness	Description
From	To		
0'	11'	11'	Dirt
11'	83'	72'	Brown Sandstone, Boulders, Gravel & Clay interbedded
83'	131'	48'	Brown Sandstone
131'	145'	14'	Gray Limestone & Brown Sandstone interbedded
145'	173'	28'	Brown Sandstone
173'	179'	6'	Gray Limestone
179'	180'	1'	Clay & Quartz Gravel (Water)
180'	204'	24'	Brown Sandstone w/ Small Clay Seams
204'	267'	63'	Gray Limestone & Small Brown Sandstone interbedded
267'	381'	114'	Gray Limestone w/ Small Clay Seams
	381'		Total Depth

Erwin Libr  
Thermal Conductivity Test  
Graph of Supply, Temp Avg, Return

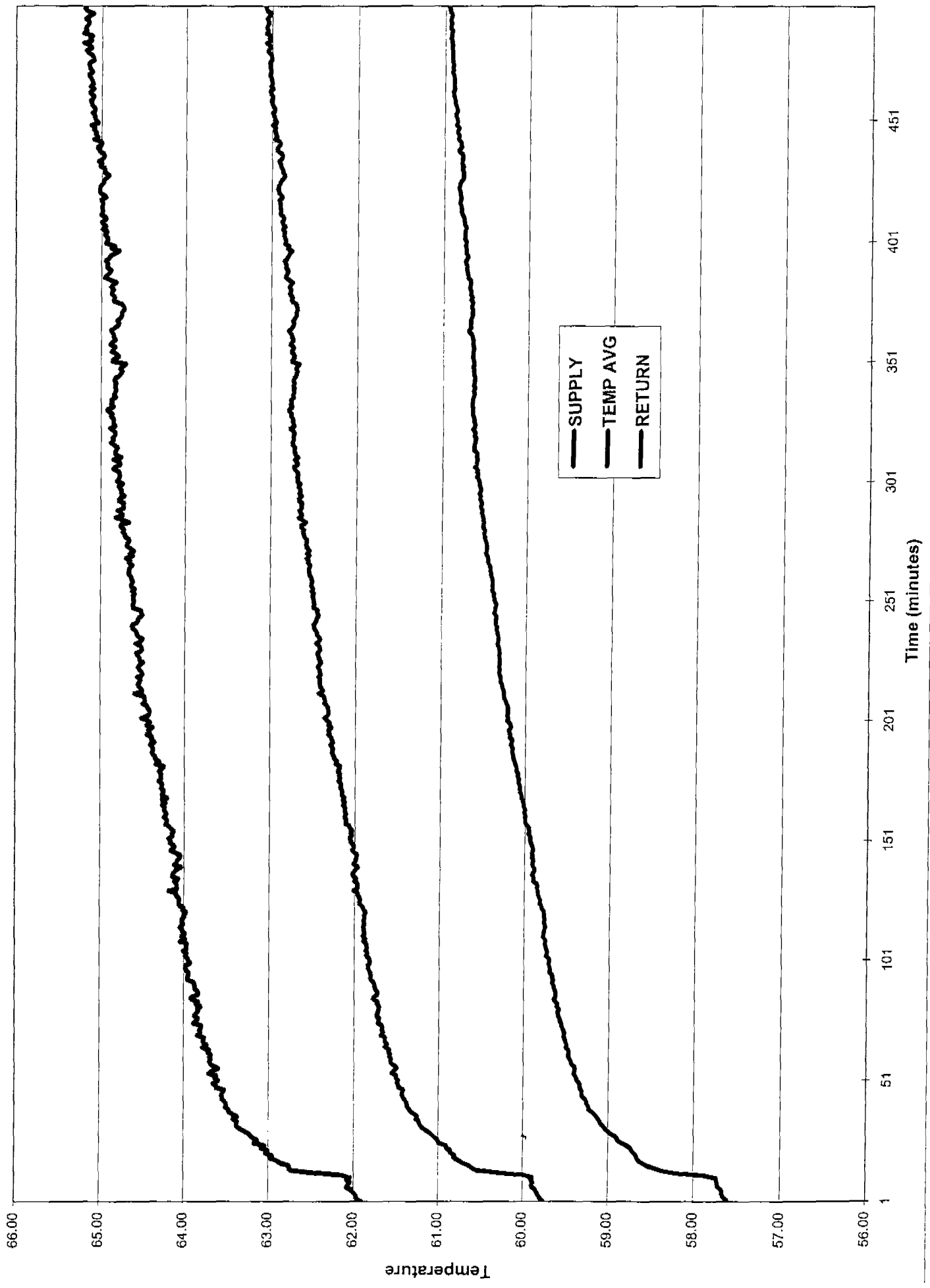




Erwin Libi  
Thermal Conductivity Test  
Graph of Log Time of Temp Avg



Unicoi Schc  
Thermal Conductivity Test  
Graph of Supply, Temp Avg, Return



Unicoi Sc  
Thermal Conductivity Test  
Graph of Log Time of Temp Avg

